

# Surgical correction of pectus excavatum and carinatum

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**ABSTRACT** This paper contains an analysis of the long-term results in 85 patients who had pectus excavatum or carinatum deformities repaired at the North Middlesex Hospital between 1951 and 1977. Seventy-seven patients had operations for correction of pectus excavatum and eight for pectus carinatum. A variety of surgical techniques was used. In the excavatum deformities the best results were obtained by the extensive resection of all deformed cartilages, the correction of the sternal deformity by a simple transverse wedge osteotomy, and by stabilising the chest with a stainless steel plate. For pectus carinatum, the involved cartilages were resected and an osteotomy of the sternum was performed. We preferred in most cases to stabilise the chest wall with a metal strut in this deformity as well. The best cosmetic results were achieved by the use of a stainless steel plate passed beneath the sternum and left for not more than six months.

Pectus excavatum or carinatum are congenital abnormalities of the anterior chest wall caused by growth disturbance of the costal cartilages. In pectus excavatum the sternum is depressed, maximally just above the xiphisternal junction, with symmetrical or asymmetrical prominence of the ribs on either side, while in pectus carinatum the lower part of the sternum is elevated, pulling the ribs towards it. The causes of these deformities are uncertain. Brodtkin<sup>1</sup> and Chin<sup>2</sup> believe that pectus excavatum is the result of excessive diaphragmatic traction on the lower sternum while Mullard<sup>3</sup> considers it to be caused by failure of osteogenesis and chondrogenesis of the anterior chest wall. Mechanical and electrocardiographic changes are uncommon.<sup>4 5</sup>

## Patients and methods

The present series includes 85 patients who had their deformities repaired by various surgical techniques during the period 1951-77. There were 49 males and 36 females. Seventy-seven patients had operations for correction of pectus excavatum and eight patients for pectus carinatum. We have analysed our findings to determine whether vari-

ations in surgical technique have caused any significant difference in the long-term results.

## Pectus excavatum

These patients have been divided into three main groups according to the operative technique: group 1 (19 patients), no stabilisation of sternum<sup>6</sup>; group 2A (12 patients), stabilisation of sternum with Steinmann pin<sup>7</sup>; group 2B (seven patients), stabilisation of sternum with Kirschner wire<sup>8</sup>; group 3 (39 patients), sternal osteotomy and stabilisation of sternum with stainless steel plate,<sup>9-11</sup> costal cartilages resected subperichondrially,<sup>6</sup> and metal strut removed electively after complete healing of the chest wall preferably between four and six months.

A bilateral submammary incision was used in all cases. The deformed costal cartilages were exposed after splitting the pectoral muscles, and resected subperichondrially. The sternum was mobilised and its position was corrected by a simple transverse wedge osteotomy.

## Results

No hospital deaths occurred. Table 1 shows the early postoperative complications that developed

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in 15 patients. All the patients have been followed for between two and 15 years. Table 2 shows the results in various groups of patients. There was a total of 10 recurrences in groups 1 and 2. All these patients had a secondary operation, the result of which was excellent in four and good in six.

Of the patients in group 3, 36 had an excellent end result and the cosmetic effect in the remaining three was acceptable. There were no recurrences in this group.

Table 1 Postoperative complications in 77 patients who underwent repair of pectus excavatum

Group	Complications
1 (19 patients)	Atelectasis 2 Paradoxical breathing 2 Pneumothorax 1 Wound infection 1
2A (12 patients)	Pneumothorax 1 Pleural effusion 1
2B (7 patients)	Wound infection 2
3 (39 patients)	Superficial wound infection 2 Wound separation 1 Skin edge necrosis 1 Pleural effusion 1

Table 2 Results of surgical correction of pectus excavatum in 77 patients

Year of operation	Operative technique	Number of patients	Results
1951-65	Group 1 (No stabilisation of sternum)	19	Excellent—5 Good—9 Recurrence—5
	Group 2A (Stabilisation with Steinmann pin)	12	Excellent—4 Good—5 Recurrence—3
	Group 2B (Stabilisation with Kirschner pin)	7	Excellent—2 Good—3 Recurrence—2
	Group 3 (Combined method)	39	Excellent—36 Good—3 Recurrence—0

### Pectus carinatum

The eight patients consisted of five males and three females whose ages ranged from 3 to 18 years. In all patients, the standard operative technique of Ravitch<sup>6</sup> was used. In three patients a metal strut was used for stabilisation of the chest wall.

### Results

There were no major complications or deaths. There was one pleural effusion which absorbed spontaneously after a few days and two wound

infections which resolved in due course. All patients have been followed for between two and 15 years. The result was excellent in the three patients who had the metal stabilisation. Of the remaining five patients the result was good in four. The deformity recurred in the fifth and another operation was required.

### Discussion

The purpose of the operation is cosmetic and psychological. Although there is no age limit for operation we feel that it is best performed during childhood. Therkelsen<sup>12</sup> and Gibbon<sup>13</sup> have advised that the operation should be carried out at an earlier age when the thoracic skeleton is softer and easier to correct.

We believe that stabilisation of the sternum in the correct anatomical position by a metal strut yields superior long-term cosmetic results. This technique also gives stability to the sternum and prevents paradoxical motion in the postoperative period.<sup>14</sup> The operative technique (combined method in group 3 patients) which has been adopted since 1966 at this Centre has produced an excellent result in most cases with no mortality and little morbidity.

The procedure described by Ravitch<sup>6,15</sup> for carinatum deformity has produced good results but we would not hesitate to use the metal strut to stabilise the chest even in this deformity.

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